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CHAIN DETONATION OF EXPLOSIVES AND DETONATION OF EXPLOSIVES IN --ETC(U)
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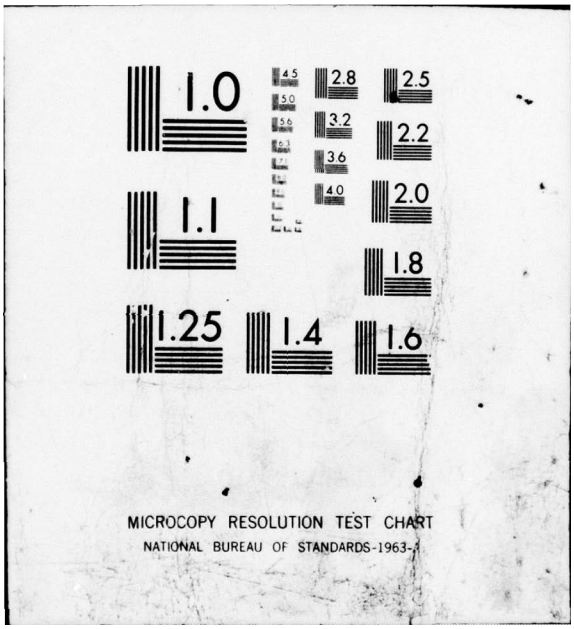
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MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

(1)

(6) CHAIN DETONATION OF EXPLOSIVES AND DETONATION OF EXPLOSIVES IN VICINITY OF CABLES+

by

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(15) Nonr-266(84)
(11) 15 Nov 61
(9) Technical memos
(12) 6 p.

A - Chain Detonation of Electrically Fired Charges

On numerous occasions it is desired to shoot a string of charges electrically without creating a chain detonation. For experimental purposes it is frequently requested that these charges be spaced as closely together as possible.

During the past year, strings of small charges have been tested and during the fall of 1961 considerable effort was expended aboard the T-Boat and Allegheny to obtain, information on larger charges.

From the theoretical standpoint, if one obtains data for one size of charge, data for other sizes may be had by recourse to the standard relationship where the breaching radius varies approximately with the cube root of the charge weight.

It was felt that field data should be taken, however, since the effect of pressure waves on the electric detonators was unknown.

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* Columbia University, Hudson Laboratories Technical Memorandum No. 61 dated 15 November 1961.

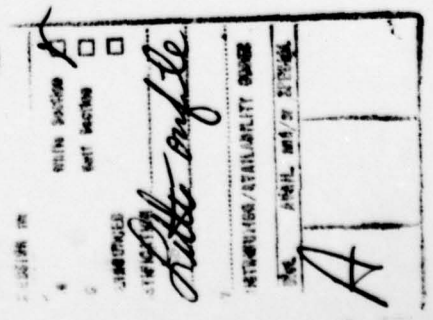
+ This work was supported by the Office of Naval Research.

The chart at the end of the report gives the safe minimum distance (determined experimentally) that various sized electrically detonated charges may be spaced without chain detonation occurring. These figures represent distances at which a charge has never chain detonated.

B - Detonation of Charges Near Wire Rope

For experimental reasons it may be desirable to shoot a string of charges from a fixed location. A ship such as the Gibbs anchored in water of 15,000 foot depth with optimum scope for maximum allowable cable tension has a swing radius of about 22,000 feet. Even in trade wind areas where the wind direction is constant, a change of wind velocity of 20 knots can cause a ship movement of about 5,000 feet. Theoretically one can anchor on a double catenary composed of chain and wire rope (we do not presently have long chain handling capacity aboard the Gibbs) or use a heavy weight and wire rope approaching a taut moored condition to reduce scope. These methods represent a compromise in which swing radius is reduced at the expense of severely reducing the limiting wind velocity. Even with these methods, the location of the ship will vary by several thousand feet.

Precise navigational methods such as Loran C, Decca radar, Raydist, Tellurometer & Transit navigation with their individual limitations can provide an improvement in information as to ship location. The fact remains, however, that one really doesn't care about ship location or for that matter the actual charge location.



If a string of charges is relatively fixed in location, one may then attempt to carry out fluctuation experiments, etc.

We are currently proposing that strings of bottom anchored shots may be detonated in deep water based upon studies conducted this fall.

In detonating charges close to a wire rope or chain a number of variables must be considered. Damage to the rope may depend upon:

(1) rope tension
(2) size of charge
(3) distance of charge from the wire rope
(4) the size and construction of the rope used
(5) the depth of the charge
(6) the method of attaching the charge to the rope
(7) the use of flash protecting devices

Early in the trials it was found that 1/4" wire rope was suitable for the work eliminating variable (4). Since reasonable results were obtained without recourse to flash protective devices, variable (7) was eliminated. Solid steel rods and bent electrical steel conduits were used for explosives support arms. The latter appeared to offer some advantages and was adopted for use in most of the tests eliminating variable (6).

Most tests were conducted in shallow water from the T-Boat using relatively low cable tensions. A check on the data obtained for all charges was run aboard the Allegheny with charges detonated at 500 to 800 feet depth with cable tensions at the charges exceeding 600 #. Therefore due consideration was given to variables (1) and (5). The

working variables were reduced to charge size and distance from the supporting wire rope.

The charges used in all tests were 2 1/2 pound M-2 charges consisting of tetrytol with a tetryl booster. Special electrical blasting caps procured through the U.S. Naval Ammunition Depot were used as detonators.

This report has been prepared as a ready reference or summary of work that has been done. Obviously much work remains to be done with different charge sizes, buoyant plastic line rather than wire rope, etc. Most of the work performed was done as a preliminary to a specific experiment. At the completion of this experiment, scheduled for January 1962, data obtained and the techniques used in launching bottom-anchored explosive strings will be reported on in a technical report.

It should be stated that Mr. R. Rico directed most of the actual explosives tests at sea, assisted at various times by E. Duffy, B. Hendrix, & C. Wobst. Since it was most difficult to completely outline these tests in advance due to the great number of variables involved, many on-the-spot decisions were necessary and the authors wish to express their thanks for this assistance.

All results are tabulated in the following chart.

Size of Charge	Distance apart in feet	# of tests run	Distance of charge from 2" wire rope ft.	# of tests run
$2\frac{1}{2}$#	4*	7	2	17
5#	5	22	3**	(4 tests @ 5 ft. (1 test @ 4 ft. distance (21 tests @ 3 ft.
10#	10***	22	3	(12 tests @ 5 ft. (3 tests @ 4 ft. (21 tests @ 3 ft.
30#	-	-	5	1

* With 2 feet spacing = chain detonation occurred
** 2 feet distance from cable - severed cable
*** It is probable that this distance can be reduced to 8 feet although experimental information is lacking.